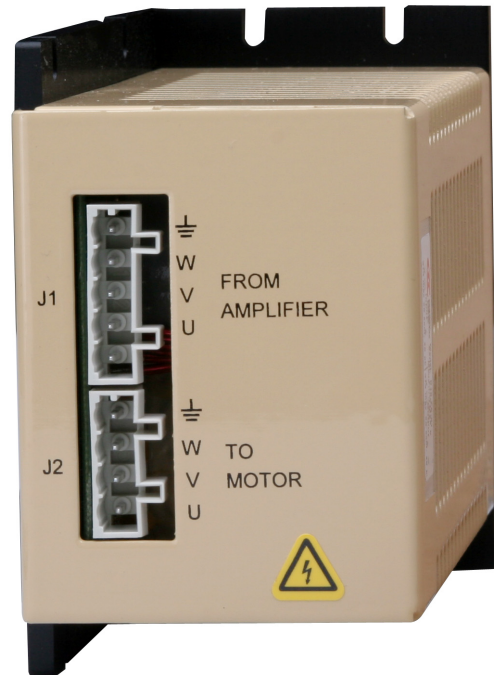


# R10-FA-01 Ruggedized Edge Filter for Xenus: User Guide



P/N 95-01178-000

Revision 1  
January 2009

## R10-FA-01 Ruggedized Edge Filter for Xenus

This page for notes.

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# ABOUT THIS GUIDE

## Overview and Scope

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This guide describes the installation and connection of the Model R10-FA-01 ruggedized series edge filter for use with ruggedized series R10 amplifiers.

## Related Documentation

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Related information is available in these Copley Controls documents:

- *Xenus XTL User Guide*
- *CME 2 User Guide*
- *Copley Controls Ruggedized Drives Standards Guide*

Information on Copley Controls Software can be found at:

<http://www.copleycontrols.com/motion/software>

## Comments

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Copley Controls welcomes your comments on this guide. For contact information, see

<http://www.copleycontrols.com>

## Copyrights

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## Document Validity

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We reserve the right to modify our products. The information in this document is subject to change without notice and does not represent a commitment by Copley Controls. Copley Controls assumes no responsibility for any errors that may appear in this document.

## Product Warnings

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Observe all relevant state, regional, and local safety regulations when installing and using this product. For safety and to assure compliance with documented system data, only Copley Controls should perform repairs.



**DANGER: Hazardous voltages.**

Exercise caution when installing and adjusting.

**Failure to heed this warning can cause equipment damage, injury, or death.**

**DANGER**



**Risk of electric shock.**

High-voltage circuits on R10 and Xenus series amplifier connectors J1, J2, and J3 and on Filter J1 and J2 are connected to mains power.

**Failure to heed this warning can cause equipment damage, injury, or death.**

**DANGER**



**Use equipment as described.**

Operate equipment within the specifications provided in this manual.

**Failure to heed this warning can cause equipment damage, injury, or death.**

**DANGER**

## Revision History

Revision	Date	DECO #	Comments
1	January 2009	18361	Initial publication.

CHAPTER

1: R10-FA-01 EDGE FILTER

This chapter provides an overview of the Model R10-FA-01 ruggedized edge filter.

The contents of this chapter include:

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## 1.1: Overview

The R10-FA-01 ruggedized edge filter can be used to minimize noise on the output of any Copley Controls ruggedized R10-Series amplifier. Like other R-Series equipment, the R10-FA-01 edge filter is designed to operate in harsh environments. It features enhanced stability over extreme temperature ranges, moisture and contamination resistance, and enhanced EMI protection.

The R10-FA-01 ruggedized edge filter is RoHS compliant.

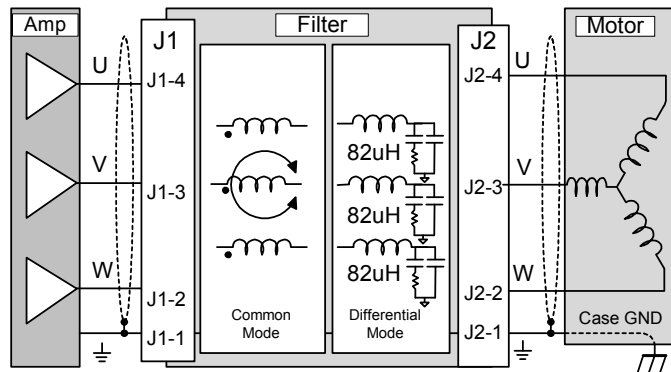
### 1.1.1: Differential and Common Mode Filtering

Most noise is capacitively coupled from the motor power cable to neighboring cables. To minimize this noise, the R10-FA-01 edge filter uses both differential edge filtering and common mode filtering. Differential edge filtering reduces the high frequency component of the PWM signal, thus producing a signal with less energy that can be coupled during transmission. Common mode filtering reduces the unnecessary common mode noise generated by PWM signals.

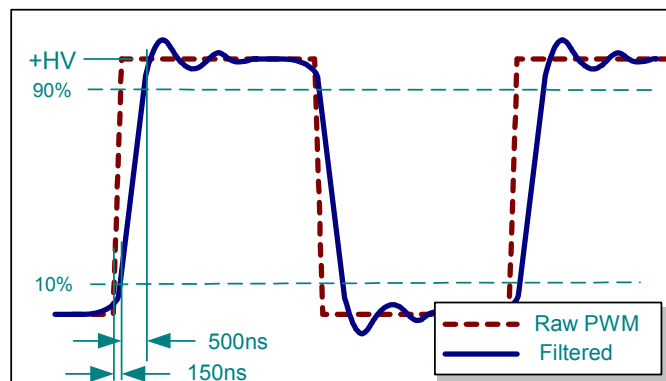
### 1.1.2: Description and Functional Diagram

The differential filter increases the rise time by at least a factor of 3, substantially reducing noise in the system. Copley Controls amplifiers typically have a 150 ns-rise time (high frequency component in the MHz range). Thus, the edge filter can increase rise time to 500 ns, reducing the high frequency noise emissions by the square law. The differential filter is designed with 82  $\mu\text{H}$  inductors and a proprietary passive circuit. The inductance will provide a total of 164  $\mu\text{H}$  in series with the load, helping to reduce ripple current. This brings low inductance motors into the required range.

The common mode filter is designed with a 220  $\mu\text{H}$  common mode toroid that works with the cable capacitance to earth ground to remove common mode switching noise.



### 1.1.3: PWM Output Plot





## 1.2: R10-FA-01 Edge Filter Specifications

Input	Voltage, maximum	373 Vdc
	Current, maximum	20 Adc
Output	Voltage, maximum	373 Vdc
	Current, maximum	20 Adc
Peak Current/Peak Current Time		40 Adc for 1 second
Rise/Fall Time		500 mS (typical)
Differential Mode Inductance		82 $\mu$ H per phase, 162 $\mu$ H phase-phase (nominal)
Common Mode Inductance		220 $\mu$ H (nominal)
Nominal Resistance		27 milliohms per leg, 54 milliohms phase-phase (nominal)
Agency Approvals		EN61010-1, RoHS

## 1.3: R10-FA-01 Edge Filter Environmental Specifications

Environmental Condition		Endurance Range	MIL-STD 810F Method	Other Standards
Ambient Temperature	Non-Operating	-50°C to 85°C	501.4, 502.4	
	Operating	-40°C to 70°C		
Thermal Shock	Operating	-40°C to 70°C in 1 minute	503.4	
Relative Humidity	Non-Operating	95% non-condensing at 60°C	507.4	
	Operating	95% non-condensing at 60°C		
Vibration	Operating	5 Hz to 500 Hz, up to 3.85 $g_{rms}$	514.5 (Figure 514.5C-2)	IEC 60068-2-6
Altitude	Non-Operating	-400 m to 12,200 m	500.4	
	Operating	-400 m to 5,000 m		
Shock	Crash Safety	75 g peak acceleration	516.5	IEC 60068-2-27
	Operating	40 g peak acceleration		

## 1.4: Application-Specific MIL Standards

There is a wide variety of application-specific electrical standards relating to the types of military and harsh environment equipment for which R-Series amplifiers and filters are intended. These include:

MIL-STD	Description
MIL-STD-1275D	Characteristics of 28 Volt DC Electrical Systems in Military Vehicles
MIL-STD-704F	Aircraft Electric Power Characteristics
MIL-STD-1399	Section 300A, Electric Power, Alternating Current
MIL-STD-1399	Section 390, Electric Power, Direct Current for Submarines

If formal testing to these application-specific electrical standards is needed, contact Copley Controls.

## 1.5: MIL-STD-461E

In general, the R-Series amplifiers and filters do not meet all of the detailed requirements of MIL-STD-461E “out of the box.” Although the enhanced EMI features designed into the R-Series provide a measurable benefit, several of the MIL-STD-461E detailed requirements are much more stringent than the commercial standards. In these applications, R-Series equipment would require additional enclosure, components, and/or shielding to achieve conformance to MIL-STD-461E.

MIL-STD-461E conformance is very application-specific. Not all of the standard’s detailed specifications are required in every application. Contact Copley for assistance with using R-Series equipment in applications requiring conformance to MIL-STD-461E.

## 1.6: Thermal Considerations

### Cooling Requirements

When used with R10-230-18 or R10 230-36 amplifiers, the R10-FA-01 operates below maximum temperature values, and thus requires no cooling fan.

When used with R10-40 amplifiers running continuous currents greater than 12 Adc, the R10-FA-01 should be cooled with an external fan. The fan should have a flow rate of at least 110 CFM. The filter has been tested using the Comair Rotron MD24B2 24 Vdc powered fan.

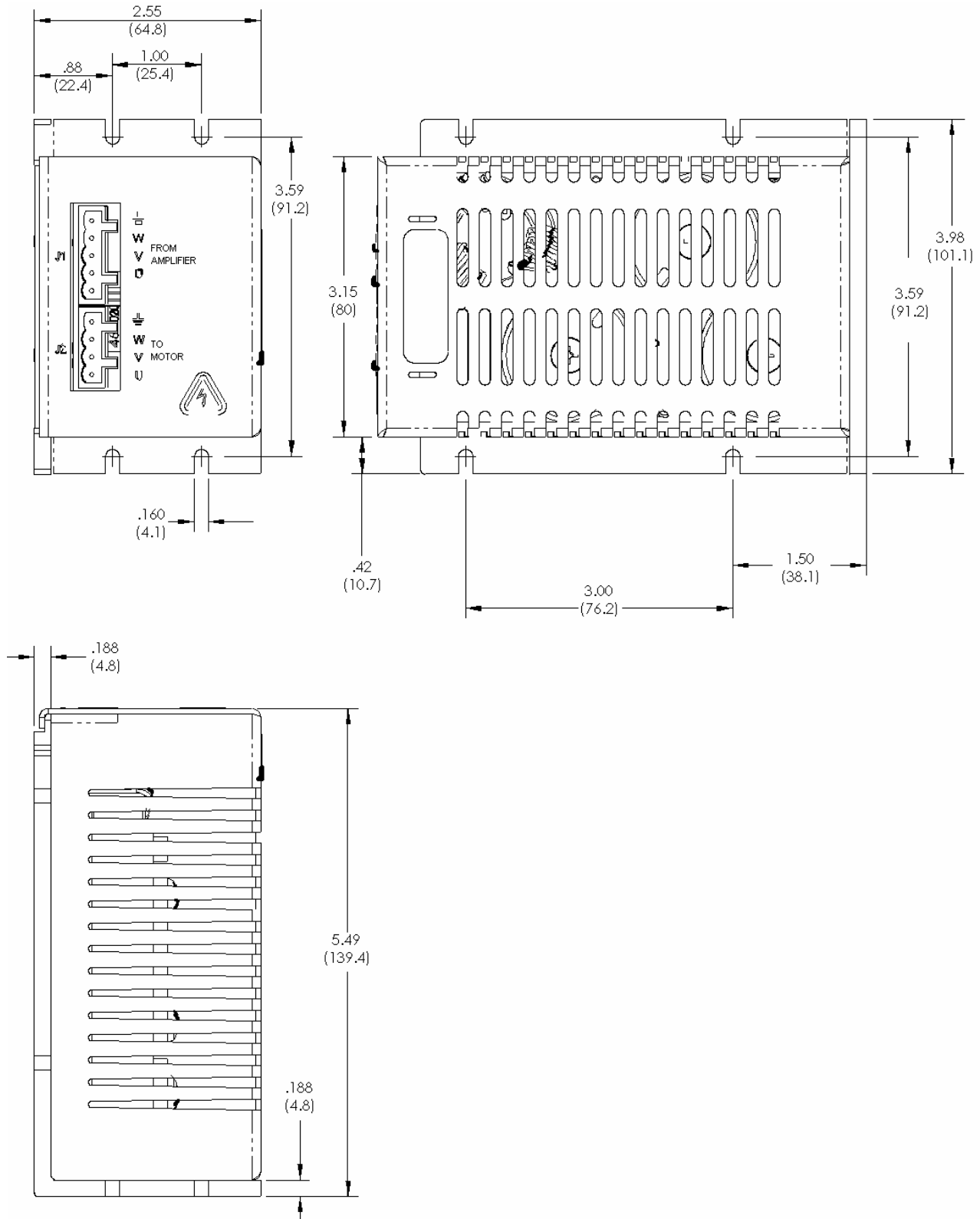
### Fan Mounting Guidelines

Most of the filter’s heat is transferred to ambient air, rather than through the heat plate. Thus, it is very important to mount the filter and fan in such a way that the fan can blow up through the filter’s cover slots. Mount the filter on edge and mount the fan below it so that it blows up through the cover slots.

There is no heatsink option for the R10-FA-01 edge filter.

## 1.7: R10-FA-01 Edge Filter Dimensions

The following diagram shows the mounting dimensions of the R10-FA-01 Edge Filter.



## 1.8: R10-FA-01 Edge Filter Wiring

This section describes the wiring of the R10-FA-01 Edge Filter.

### 1.8.1: Electrical Codes and Warnings

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Be sure that all wiring complies with the National Electrical Code (NEC) or its national equivalent, and all prevailing local codes.



**DANGER: Hazardous voltages.**

Exercise caution when installing.

**Failure to heed this warning can cause equipment damage, injury, or death.**

**DANGER**



**Risk of electric shock.**

High-voltage circuits on R10 and Xenus amplifier connectors J1, J2, and J3 and on Filter J1 and J2 are connected to mains power.

**Failure to heed this warning can cause equipment damage, injury, or death.**

**DANGER**



**Do not ground mains-connected circuits.**

With the exception of the ground pins on R10 and Xenus amplifier connectors J1, J2, and J3 and on Filter J1 and J2, all of the other circuits on these connectors are mains-connected and must never be grounded.

**WARNING**

**Failure to heed this warning can cause equipment damage.**

### 1.8.2: Connector Locations

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Edge Filter J1 connects to amplifier J2. Edge Filter J2 connects to the motor.



### 1.8.3: Cable Notes

- 1 Keep the Edge Filter J1 to amplifier J2 cable as short as possible. A typical length is 7 inches.
- 2 To reduce noise, twisted shielded cable must be used and the signal cables should not be bundled in the same conduit.

### 1.8.4: Input (J1) From Amplifier

#### Mating Connector

Description	Euro-style, 5 position, 5.0 mm pluggable female terminal block
Manufacturer PN	Wago 51118042 or 721-105/026-047/RN01-0000
Wire Size	22 - 12 AWG
Recommended Wire	12 AWG, 600 V (Shielded cable used for CE compliance)
Wire Insertion/Extraction Tool	Wago 231-131
Connector and tool are included in connector kit R10-FK.	

#### Pin Description

Pin	Signal	Function
1	Ground	Chassis ground and cable shield
2	Phase W	Phase W input from amplifier
3	Phase V	Phase V input from amplifier (use for DC motor connection)
4	Phase U	Phase U input from amplifier (use for DC motor connection)
5	---	No connection

### 1.8.5: Output (J2) To Motor

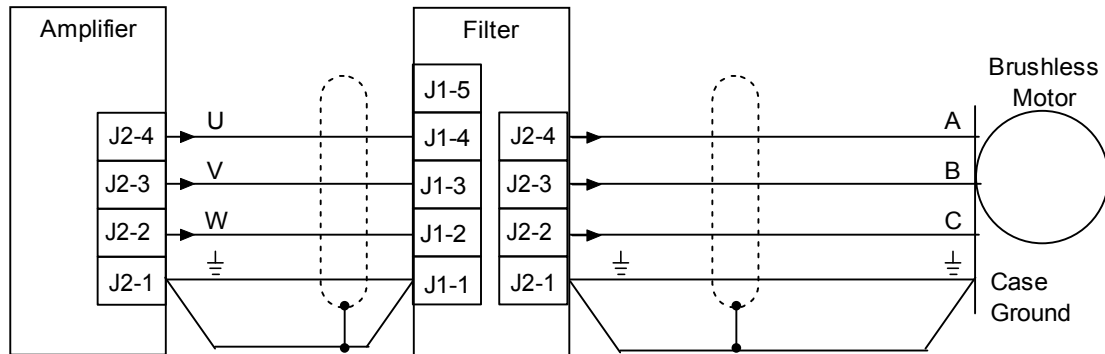
#### Mating Connector

Description	Euro-style, 4 position, 5.0 mm pluggable female terminal block.
Manufacturer PN	Wago 51118008 or 721-104/026-047/RN01-0000
Wire Size	22 - 12 AWG
Recommended Wire	12 AWG, 600 V (Shielded cable used for CE compliance)
Wire Insertion/Extraction Tool	Wago 231-131
Connector and tool are included in connector kit R10-FK.	

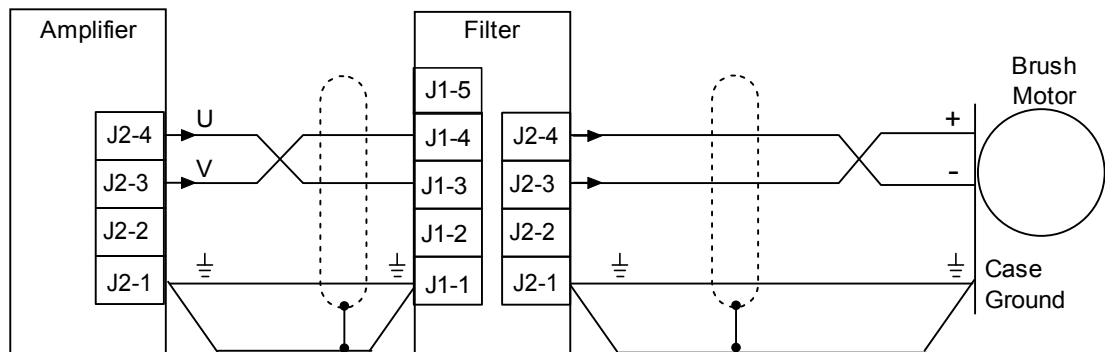
#### Pin Description

Pin	Signal	Function
1	Ground	Chassis ground and cable shield
2	Phase W	Phase W output to motor
3	Phase V	Phase V output to motor (use for DC motor connection)
4	Phase U	Phase U output to motor (use for DC motor connection)

### 1.8.6: Diagram: Edge Filter Wiring with Brushless Motor



### 1.8.7: Diagram: Edge Filter Wiring with Brush Motor



## 1.9: R10-FA-01 Edge Filter Ordering

### Filter

Model	Description
R10-FA-01	R10 Ruggedized Edge Filter

### Connector Kit

Model	Qty	Ref	Description	Mfr.Model No.
R10-FK	1	J1	Plug, 5 position, 5.0 mm, female	Wago 51118042 or 721-105/026-047/RN01-0000
	1	J2	Plug, 4 position, 5.0 mm, female	Wago 51118008 or 721-104/026-047/RN01-0000
	2	--	Insertion / Extraction Tool	Wago 231-131





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